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published in
Journal of International Financial Markets, Institutions and Money
2019

DOI (link to publisher)
10.1016/j.intfin.2019.01.001

document version
Publisher's PDF, also known as Version of record

J. Int. Financ. Markets Inst. Money 60 (2019) 252–266

Contents lists available at ScienceDirect

Journal of International Financial Markets, Institutions & Money

journal homepage: www.elsevier.com/locate/intfin

Macro-financial regimes and performance of Shariah-compliant equity portfolios

Kris Boudt [a,b,f], Muhammad Wajid Raza [c,d], Dawood Ashraf [e,*]

[a] Vrije Universiteit Brussel, Belgium
[b] Vrije Universiteit Amsterdam, the Netherlands
[c] Vrije Universiteit Brussel, Belgium
[d] Shaheed Benazir Bhutto University, Dir, Pakistan
[e] Islamic Research and Training Institute (A member of Islamic Development Bank Group), 8111 King Khalid Street, Al Nuzlah Al Yamania Dist., Jeddah 22332-2444, Saudi Arabia
[f] Ghent University, Belgium

ARTICLE INFO

Article history:
Received 5 September 2018
Accepted 15 January 2019
Available online 22 January 2019

Keywords:
Shariah-compliant investing
Market capitalization
Fundamental-weighting
Equal-weighting
Low-risk weighting

ABSTRACT

This study proposes the Markov Regime Driven Style allocation (MRDS) strategy for Shariah-compliant portfolio construction, a forward-looking methodology that merges economic forecasting with Shariah-compliant investment principles. By using Shariah-compliant equities from the S&P 500 universe over the period 1986–2016, we find that a Shariah-compliant investor can achieve stable performance by dynamically allocating across investment styles determined from the macro-financial information, as compared with various single style strategies. The MRDS improves both the level and stability of relative performance. This strategy also successfully mitigates risk by reducing volatility, value-at-risk, and portfolio drawdowns.

"Investment strategies will also wax and wane, performing well in certain environments and performing poorly in other environments."

[*Andrew* Lo, 2004.]

The two-fund separation theorem of Tobin (1958) prescribes that mean-variance efficient investors allocate their portfolio to a risk-free asset and risky assets with the aim to maximize their expected returns at a given level of risk. While the result has been seminal in modern finance theory, it is of little relevance for the Shariah-compliant equity investor due to business and finance-related restrictions. A Shariah-compliant investor may not invest in the shares of those companies engaged in the production of goods and services related to alcohol, tobacco, gambling, adult entertainment, weapons, swine, media and broadcasting, borrowing and/or lending based on *Usury* (interest), or game of chance (excess speculation). The restrictions on investments reduce the investable universe of equities for Islamic investors (Arslan-Ayaydin et al., 2018; Ashraf, 2016).

Implementing those restrictions involves screening stocks from an investment universe and then selecting an asset allocation strategy. Ashraf and Khawaja (2016) structured Shariah-compliant equity portfolios using a market-capitalization approach and found that Shariah screening reduces the investable universe to almost half with minimal difference in performance as compared with unscreened portfolios. As an alternative, Boudt et al. (2017) investigated the use of so-called

* Corresponding author.
E-mail address: dashraf@isdb.org (D. Ashraf).

https://doi.org/10.1016/j.intfin.2019.01.001
1042-4431/

smart beta strategies for Shariah-compliant equity investors. Their findings suggest that portfolio construction methodology such as market capitalization, fundamental value, low-risk strategy, and equal-weighting affects the risk-adjusted performance of Shariah-compliant equity portfolios. However, there is no theoretical or empirical evidence suggesting that either of these weighting styles always outperforms the others. Furthermore, the performance of Shariah-compliant portfolios exhibit cyclical behavior and outperform conventional portfolios especially during a bearish trend (Boudt et al., 2017; Ashraf and Mohammad, 2014).

The time variation in performance presents an opportunity for investors to exploit regime-specific investment opportunities. The existence of such an opportunity is ultimately both an empirical and methodological question for which we provide an answer in this paper. Our central question is therefore: "Whether and how investors benefit from dynamic style allocation in a Shariah-compliant framework". Several papers have addressed this issue for conventional portfolios however, there is no such study that have proposed a dynamic asset allocation strategy with regime-switching for Shariah-compliant investors. This study attempts to fill this gap. From Raza and Ashraf (2018) and Boudt et al. (2017), we know that Shariah screening substantially changes the performance properties of single style portfolios. It is thus important to investigate this question under the restriction that the equity universe needs to be Shariah-compliant. The proposed dynamic allocation strategy switches among available investment styles based on the macro-financial regimes. The resulting "Markov Regime Driven Style allocation" (MRDS) portfolio exploits market timing and diversification opportunities to improve stability in financial performance compared to single-style Shariah-compliant equity portfolios.

The out-of-sample evaluation of the resulting dynamic style portfolio suggests that the MRDS strategy improves financial performance stability in terms of lower volatility, lower maximum drawdowns, and comparatively lower value-at-risk. The stability in financial performance results in the MRDS strategy outperforming all other single style Shariah-compliant portfolios considered in this study, in terms of raw and risk-adjusted returns and the equal-weighted style diversification benchmark.

This study adds to the existing literature in two ways. Firstly we show that time-varying performance of single style Shariah-compliant portfolios are partly driven by macro-financial regimes. Second, we introduce and test the concept of dynamic style allocation in Shariah-compliant equity portfolio construction. Given the importance of equity investing for the Shariah-compliant investor, we are confident that the proposed dynamic style portfolio is a useful addition to the financial toolkit of Shariah-compliant investors. Thanks to this instrument, they can achieve stability in portfolio returns by timely adapting their investment portfolio as a function of the time-varying risk-reward properties of a single style Shariah-compliant equity portfolio.

The rest of the chapter is organized as follows. Section 1 presents the data and methodology for constructing a single style portfolio. Section 2 highlights the motivation for developing a dynamic allocation strategy for Shariah-compliant investors. Section 3 highlights the in-sample regimes in macro-financial variables. Section 4 presents the regime-driven style allocation used in this study. Section 5 presents the main analysis of the out-of-sample performance of the MRDS portfolio in comparison to single style Shariah-compliant portfolios. Section 6 concludes this article.

1. Data sources and single style portfolio construction methodology

1.1. Data

In this study, we use the constituents of S&P 500 as the reference investment universe for the period 1986–2016. To obtain Shariah-compliant portfolios we use the Dow Jones Islamic Market Indices (DJIMI) two-step Shariah screening guidelines.[1] In the first step, we implemented business screening by using global industrial classification standards (GICS) and exclude those firms whose major business is in contradiction with Islamic business screening guidelines. In the second step, we use financial screening and exclude all remaining firms whose cash and short-term investments exceed 33% of market capitalization, or whose account receivables balance exceeds 33% of market capitalization, or whose total debt exceeds 33% of market capitalization. The GICS and fundamental data is retrieved from COMPUSTAT database on a quarterly basis.

For performance evaluation, we obtain the month-end adjusted price data of all S&P 500 constituents from the COMPUSTAT database. Through the choice of weighting method, the resulting Shariah-compliant universe is mapped into portfolios.

In order to capture the macro-financial regimes, we use the monthly data of interest rates and CAPE from the official website of Robert J. Shiller. The data for changes in industrial production is obtained from the Federal Reserve Economic Data (FRED) website.[2]

1.2. Single style Shariah-compliant portfolios

Boudt et al. (2017) investigated the impact of four different portfolio allocation styles on Shariah-compliant portfolios and found that these styles exploit different risk premium and lead to difference in financial performance during times of eco-

[1] Shariah-compliant equity portfolios are guided by Islamic jurisprudence principles whereby any investment opportunity involving *Riba* (interest), *Gharar* (excessive risk), *Maisir* (gambling), and *Al-mujazafah* (speculation) is prohibited. In addition, investment in firms whose core operations are based on the production or distribution of swine, alcohol, tobacco, weapons, media and broadcasting, and adult entertainment is also prohibited (Arslan-Ayaydin et al., 2018).

[2] Data is retrieved from http://www.econ.yale.edu/shiller/data.htm.

nomic turmoil. For example, the low-risk strategy which overweights low beta stocks under-performs the market capitalization portfolio in bull markets and outperform in bear markets. The same findings hold in the absence of Shariah constraints (Ardia et al., 2016). Next we discuss the portfolio construction methodology for all four portfolio investment styles.

1.3. Market capitalization-weighting

In a market capitalization-weighted portfolio the individual portfolio components are weighted based on their market value. The stock's weight in the case of a Shariah-compliant market capitalization portfolio is given by:

$$w_{i,t}^{MC} = \frac{P_{i,t} \cdot n_{i,t} \cdot I_{i,t} \cdot S_{i,t}}{\sum_{j=1}^{N_t} P_{j,t} \cdot n_{j,t} \cdot I_{j,t} \cdot S_{j,t}}, \tag{1}$$

where N_t is the number of stocks in the overall universe on date t, $P_{i,t}$ is the stock price of individual firm i at time period t, and $n_{i,t}$ is the number of common stocks outstanding of equity issuing firm i at time t. The dummies $I_{i,t}$ and $S_{i,t}$ ensures that the equity-issuing firm belongs to S&P 500 and is Shariah-compliant at time t.

This strategy has the advantage of lower turnover and the ability to represent a broadly invested portfolio. This strategy is widely used by most of the world's leading index providers, e.g., the Dow Jones Islamic Market Indices and S&P 500 Shariah indices. Because of the skewness in market capitalization, a portfolio constructed with market capitalization strategy is concentrated in large capitalization stocks. Moreover, since weights depend on the share value, it is therefore directly exposed to stock mispricing.

1.4. Fundamental value-weighting

The fundamental value-weighting strategy is typically implemented by setting the portfolio weights proportional to four accounting-based measures of firms' fundamental indicators. The weights assigned are estimated by taking the mean of the normalized version of the book value of common equity, and five-year rolling averages of the yearly value of dividends, sales, and net operating cash flows. The fundamental weights for a Shariah-compliant portfolio are determined by:

$$w_{i,t}^{FW} \equiv \frac{1}{4}\sum_{k=1}^{4}\left(\frac{\max\{x_{k,1},0\} \cdot I_{i,t} \cdot S_{i,t}}{\sum_{j=1}^{N_t}\max\{x_{k,j},0\} \cdot I_{j,t} \cdot S_{j,t}}, \ldots, \frac{\max\{x_{k,N},0\} \cdot I_{j,t} \cdot S_{j,t}}{\sum_{j=1}^{N_t}\max\{x_{k,j},0\} \cdot I_{j,t} \cdot S_{j,t}}\right), \tag{2}$$

where $x_{1,i}$ is the size of firm i measured as the book value of the firm's common equity. The variables $x_{2,i}, x_{3,i}$ and $x_{4,i}$ represent the five-year trailing averages of the yearly value of dividends, net operating cash flow, and sales respectively. The trailing averages are used to avoid excessive volatility in the final weights caused by variation in fundamental indicators.

1.5. Equal-weighting

The equal-weighting approach assigns equal-weights to each stock in the portfolio with weights obtained as follows:

$$w_{i,t}^{EW} = \frac{I_{i,t} \cdot S_{i,t}}{\sum_{j=1}^{N_t} I_{j,t} \cdot S_{j,t}}, \tag{3}$$

where N_t is the number of stocks included in the universe at time t.

This strategy is commonly known as a naive diversification approach as it ignores the company's stock risk and return characteristics in the allocation decision. Equally weighted portfolios are easily constructed and provide perfect diversification in terms of capital allocation (Plyakha et al., 2014).

1.6. Low-risk weighting

The focus of the low-risk strategy is to enhance portfolio performance by reducing overall risk. In this study, the low-risk strategy is implemented by using the heuristic approach which first selects low-risk stocks and then weights the stock inversely based on their risk characteristics as discussed by Chow et al. (2014). The weights are then obtained as follows:

$$w_{i,t}^{LR} = \frac{\frac{1}{\sigma_{i,t}} \cdot I_{i,t} \cdot S_{i,t} \cdot L_{i,t}}{\sum_{j=1}^{N_t} \frac{1}{\sigma_{j,t}} \cdot I_{j,t} \cdot S_{j,t} \cdot L_{j,t}}, \tag{4}$$

where $\frac{1}{\sigma_{i,t}}$ is the inverse volatility of stock i at time t, and $L_{i,t}$ is the dummy indicating that the selected stock is among the 100 least volatile Shariah-compliant stocks in the S&P 500 universe at selection date t. We take the volatility estimated over a 24-month rolling window.

2. Rationale for Shariah-compliant dynamic allocation strategy

For designing a successful dynamic allocation strategy, a natural starting point is to answer three preliminary questions. First, whether the performance of various style portfolios is different from each other? Second, whether the performance of the single style Shariah-compliant portfolio is time-varying? And third, what are the macro-financial factors that can be utilized for a regime-specific dynamic allocation strategy?

To answer the first question, we investigate the risk-return performance of Shariah-compliant style portfolios and set of mean variance efficient portfolios (MVPs) by assuming no short sales for the full sample period 1986–2016. It is important to mention here that the relative position of a Shariah-compliant portfolio cannot be evaluated with Tobin's two-fund separation theorem with risk free assets. Therefore, each portfolio on the efficient frontier is evaluated purely on the basis of returns relative to a specific level of risk. We denote this ratio by the Risk-Adjusted Return (RAR), given by:

$$RAR = \frac{\hat{\mu}}{\hat{\sigma}}, \tag{5}$$

where $\hat{\mu}$ is the average portfolio return and $\hat{\sigma}$ is the standard deviation of portfolio returns.

The black curve in Fig. 1 shows the mean-variance efficient frontier of long-only portfolios that are fully invested in the four single-style portfolios. It is evident from Fig. 1 that the difference in allocation style may result in different risk and return profiles. The tangent line[3] from the origin and the intersection point at the efficient frontier is the maximum risk-adjusted returns for all considered Shariah-compliant portfolios and suggest that better risk-adjusted returns are possible by combining different single style Shariah-compliant portfolios.

To understand the time-varying performance characteristics of single style Shariah-compliant portfolios, we divide the full sample period into six sub-sample periods, based on five-year time windows. Fig. 2 plots single style Shariah-compliant portfolios and the efficient frontier of MVPs. The shifting position of the efficient frontier and the changing positions of single style Shariah-compliant portfolios provide evidence of time-varying returns attributes and motivates our approach to improve portfolio performance through dynamic allocation strategy. Regime-specific information are often used to design dynamic allocation strategies and they tend to outperform static investment strategies (Clarke and de Silva, 1998).

Studies conducted by Ang and Bekaert (2002, 2004) and Guidolin and Timmermann (2007) showed that using a regime switching model significantly improves the risk-adjusted returns of portfolios. However, instead of a direct modeling of regimes in returns, we follow Kritzman et al. (2012) and combine economic forecasting with portfolio construction. To understand whether macro-financial factors partially drive the difference in relative performance of Shariah-compliant equity portfolios, we identify the following variables.[4]

2.1. Interest rate

The changes in interest rates (rising vs declining interest rates) are associated with tightening and expansion of monetary policy and affects the cost of capital for firms. This variable has special implications for Shariah-compliant investors because it directly affects both the screening and weighting of Shariah-compliant equity portfolios.[5]

2.2. CAPE

The CAPE is defined as market price divided by the moving average of ten years of earnings, adjusted for inflation. CAPE, introduced by Shiller (2000), is commonly used to assess whether the market is undervalued or overvalued. Bunn et al. (2014) showed that superior performance is possible by following a sector rotation strategy with investment in those sectors identified as undervalued by CAPE-based valuation signals.

2.3. Volatility in the stock market

Stock markets exhibit cyclical volatility with high volatility mostly associated with bearish markets and low volatility with bull markets (Hsu and Li, 2009). Following a simple style rotation strategy based on market volatility, Copeland and Copeland (1999) found that the style rotation strategy outperforms the single style of investment strategies. We estimate market volatility as the standard deviation of daily returns of S&P 500 stocks.

[3] Note that this tangent line is not the capital allocation line between a risky portfolio and cash. Such a combination is not feasible for Shariah-compliant investors because cash is not considered as an investment for Shariah-compliant investors. Furthermore, all existing Shariah screening standards limit the holding of liquid assets to a predetermined level usually not exceeding one-third of total assets (Ashraf and Khawaja, 2016).

[4] The reason for selecting these four variables is their relative ability to represent a unique aspect of the overall economy. However, the variables we considered are not meant to be exhaustive.

[5] The screening is mandatory and fixed by the Shariah boards. The financial screens prohibit investing in firms with high interest revenue or a high level of financial leverage. The change in interest rates have implications for Shariah-compliant equity investors as it can effect both diversification opportunities and cash-flows of firms.

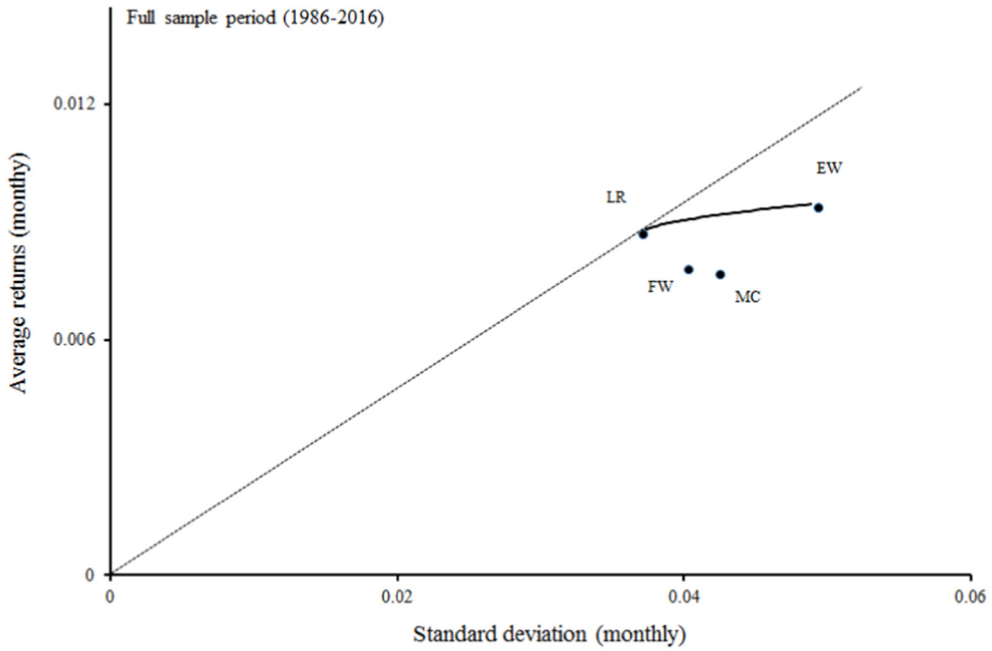

Fig. 1. Efficient frontier of Shariah-compliant equity style portfolios. *Note:* The dots around the efficient frontier shows the performance of single style Shariah-compliant portfolios for the period 1986–2016 for market capitalization-weighted portfolio (MC), fundamental value-weighted portfolio (FW), equal-weighted portfolio (EW), and low-risk weighted portfolio (LR) respectively. The dotted line is the tangent line from the origin to the efficient frontier. Its slope corresponds to the risk adjusted returns ratio (RAR).

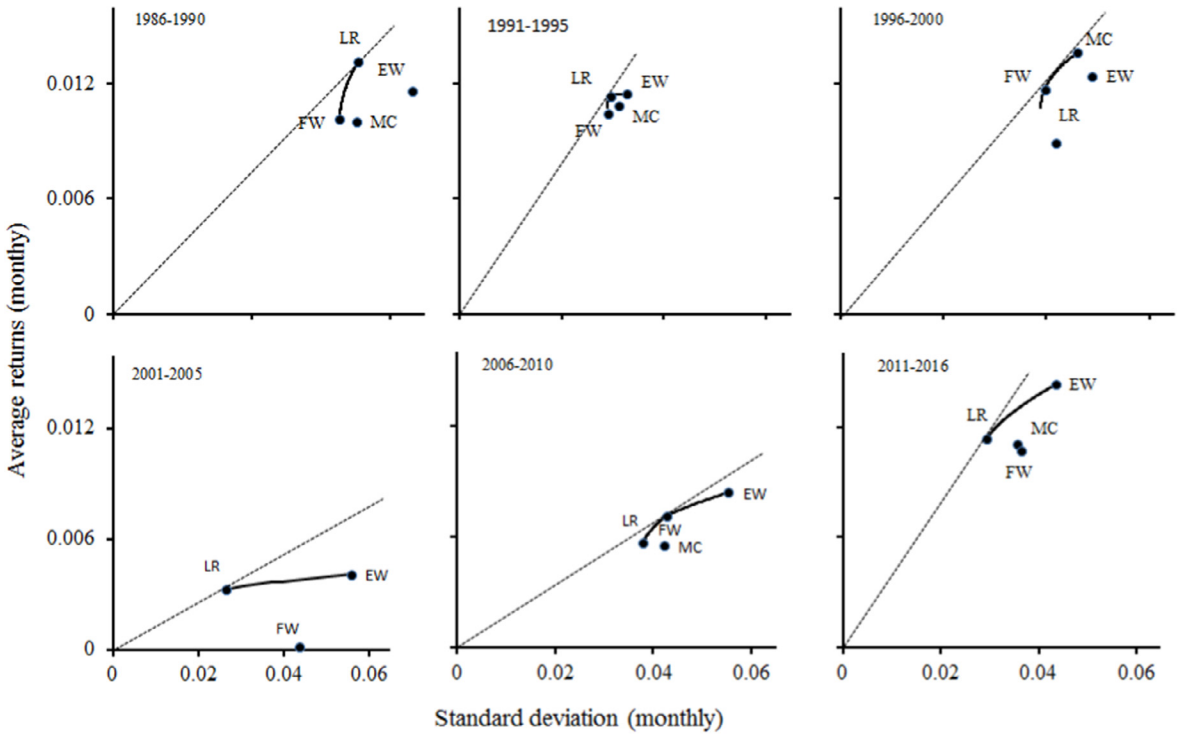

Fig. 2. Efficient frontiers of Shariah-compliant equity-style portfolios for sub-periods. *Note:* The symbols MC, FW, EW, and LR represent market capitalization, fundamental value, equal, and low-risk weighted portfolios respectively. In 2001–2005, the average return for the Shariah-compliant market capitalization-weighted portfolio is negative and not shown on the plot.

2.4. Industrial production

Industrial production is an indicator of economic growth and captures the structural development in the economy. To capture the impact of economic growth, we use the industrial production index published by the Federal Reserve Economic Data (FRED).

Fig. 3 shows regimes specific average weights allocation to each sector by Shariah-compliant portfolios. The weights are conditional based on the probability of state variables to be in high or low regimes. For brevity, we only report the weights of information technology (IT), healthcare, consumer staples, and industrial sectors.

Fig. 3 provides two interesting findings. First, the sector allocation of Shariah-compliant equity styles is less sensitive to changes in industrial production as compared with other macro-financial regimes. Second, information technology and industrial sectors are more sensitive to macro-financial regimes as compare to health care and consumer staples. Furthermore, in the case of declining interest rates, low market volatility, CAPE and industrial production, all strategies except the low-risk strategy show higher exposure to the IT sector.

Table 1 presents the performance of individual style portfolios based on regimes in macro-financial variables for the full sample period. A high(low) regime is identified if the macro-financial variable is greater(lower) than its historical median value. We evaluate the performance of single style Shariah-compliant portfolios with average returns, volatility, and risk-adjusted returns (measured with RAR).

One of the important findings from Table 1 is that all Shariah-compliant portfolios reflect different average returns, standard deviation, and risk-adjusted returns during rising and declining regimes in all four macro-financial variables. The dynamic allocation strategy utilize the variation in performance of single style Shariah-compliant equity portfolios.

3. In-sample regimes in macro-financial variables

In this section we show the in-sample identification of regimes during changing interest rates, CAPE, industrial production, and market volatility using the Markov-switching model. The results in Table 2 confirm that the model successfully identified two regimes with high persistence. It is interesting to note that rising interest rates and high market volatility are characterized by a relatively higher mean and standard deviation. While the declining CAPE and industrial production are characterized by higher volatility. The declining regimes in interest rates, CAPE, industrial production, and high market volatility are characterized by lower degrees of freedom indicating that these regimes have larger shocks.

Fig. 4 plots the smoothened probabilities of each of the macro-financial variables in a high regime vs. actual values. It is evident that the model has successfully identified the severe upward or downward moments in all four variables. In most cases the sharp increase in the macro-financial variables is identified with high accuracy. Although the regimes in the four macro-financial variables are not identified simultaneously all the time, there is a correlation between the existence of high regimes (e.g., periods around the Dot-com equity crises).

3.1. In-sample performance of Shariah-compliant equity style portfolios

Table 3 presents the performance of Shariah-compliant portfolios from the full sample and sub-samples based on regimes identified by the Markov regime switching model. At this point we do not link macro financial regimes to identify a specific style equity premium rather, the objective is to understand the relative performance across all Shariah-compliant portfolios in different macro-financial regimes.

One of the important findings from Table 3 is that better performance is expected from most Shariah-compliant style portfolios when CAPE and industrial production are rising. However, the returns of market capitalization, fundamental value-weighted, and equal-weighted strategies are less consistent when interest rates, CAPE, and industrial production are declining. In the case of high market volatility, the low-risk strategy has superior risk-adjusted returns. While during periods of low market volatility, the market capitalization and fundamental value-weighted strategies show relatively high risk-adjusted returns.

4. Regime-driven style allocation

The aim of our research is to build a dynamic allocation strategy and backtest its out-of-sample performance. We develop a forward-looking methodology which combines portfolio construction with micro-financial forecasting. The out-of-sample investment decision is based on regime-specific conditional returns and conditional volatility. The out-of-sample conditional returns and conditional volatility are predicted for the four Shariah-compliant equity portfolios by following the methodology of Ang and Bekaert (2004). Portfolio rebalancing is allowed at times $t = 1, 2, \ldots, T$. At each rebalancing date t, a decision is made to invest in the style for which the performance best fits with the regimes in a specific macro-financial variable. In the subsections below we present the steps to design the dynamic allocation strategy.

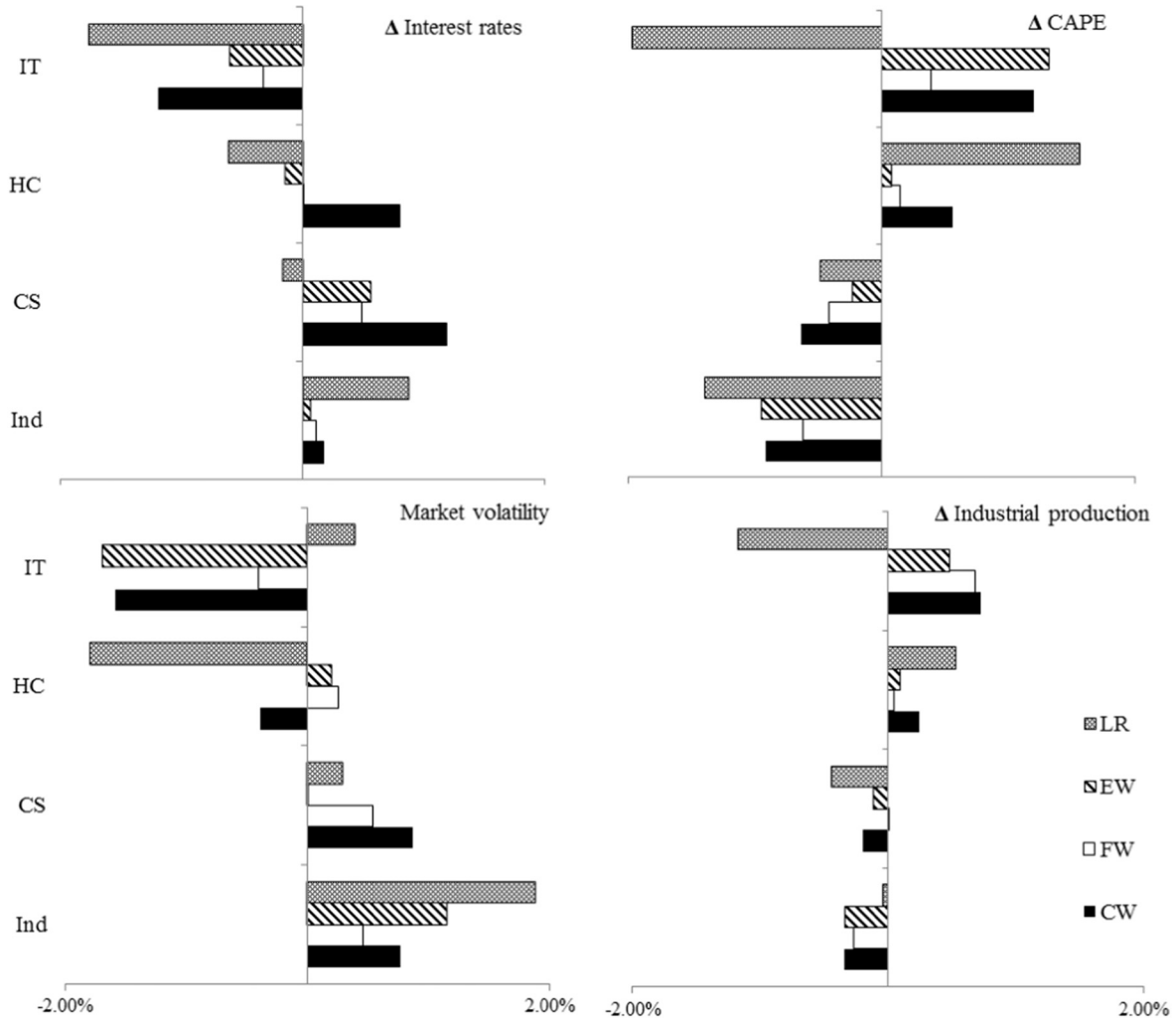

Fig. 3. Average differences in sector weights between high and low macro-financial regimes in the information technology, health care, consumer staples, and industrial sectors, for the market capitalization, fundamental value, equal and low-risk weighted portfolios. *Note:* This figure shows the time series average of the difference in sector allocation of Shariah-compliant portfolio high and low regimes. The plot is obtained by subtracting the average weights of a sector in a high regime minus average weights in a low regime for the period 1986–2016.

4.1. Regime identification

Each macro-financial variable can take two states i.e., high regimes (rising values) and low regimes (declining values).[6] In both regimes, it is assumed that the density function follows a student t distribution. $\mu_{i,t}, \sigma_{i,t}$ and $v_{i,t}$ denote the mean, standard deviation, and the degrees of freedom in regime i for each rebalancing date t. The parameters in one regime can be different from the other $(i \in \{H, L\})$. We calibrate a two-regime Markov switching model to estimate the regimes in each state variable. We assumed two hidden Markov states and estimate the model by maximum likelihood as in Hamilton (2010).

An important step is to decide the critical value for high and low regimes. We use a cut off level of 50% to decide the high and low regimes such that a regime is identified if the predicted probability is above 50%. From the above classification of regimes we can then predict the probability of being in a low regime or high regime in the next period. We denote $\pi_{L,t+1|t}$ (resp. $\pi_{H,t+1|t}$) as the predicted probability for the macro-financial variable to be in a low (resp. high) regime at time t + 1, conditional on the information available at time t.

[6] The regimes can be classified into more than two states as discussed by Guidolin and Timmermann (2007). However, more than two states can increase portfolio turnover which significantly effects the net returns of portfolios and are also cumbersome to estimate. Therefore, we follow Ang and Bekaert (2002, 2004) and Kritzman et al. (2012) and assume that the variable can only take two states.

Table 1
The average returns, volatility, and risk-adjusted returns of single style Shariah-compliant portfolios in full sample and sub-sample based on high and low values for macro-financial variables.

	Full sample	ΔInterest		ΔCAPE		Volatility		ΔInd prod	
		High	Low	High	Low	High	Low	High	Low
Panel A: Market capitalization-weighted portfolio									
Average returns (%)	8.51	6.92	10.70	20.82	1.64	0.28	16.75	12.00	4.96
Standard deviation (%)	14.73	13.94	15.41	11.34	0.16	17.68	10.50	14.98	14.59
RAR	0.57	0.49	0.69	1.83	0.09	0.01	1.59	0.80	0.34
Panel B: Fundamental value-weighted portfolio									
Average returns (%)	8.78	6.98	11.20	21.00	1.35	0.64	16.98	11.30	6.16
Standard deviation (%)	13.97	13.41	14.41	10.81	15.76	16.65	10.12	14.30	13.67
RAR	0.62	0.52	0.77	1.94	0.08	0.03	1.67	0.79	0.45
Panel C: Equal-weighted portfolio									
Average returns (%)	10.37	6.66	15.01	21.46	1.38	0.47	20.42	10.60	9.98
Standard deviation (%)	17.08	15.70	18.18	12.24	20.23	20.52	12.08	16.79	17.45
RAR	0.60	0.42	0.82	1.75	0.06	0.02	1.69	0.63	0.57
Panel D: Low-risk weighted portfolio									
Average returns (%)	10.15	7.97	12.80	20.81	1.31	2.54	17.63	9.96	10.26
Standard deviation (%)	12.86	13.27	12.39	10.41	14.18	15.29	9.27	13.26	12.52
RAR	0.78	0.60	1.03	1.99	0.09	0.16	1.90	0.75	0.81‘

Note: This table reports average returns, volatility (measured as standard deviation) and risk-adjusted returns (RAR) of the four Shariah-compliant equity portfolios on a monthly basis. The analysis is based on monthly returns for the period January 1986 to December 2016 with monthly rebalancing. The high and low regime classification is carried out by comparing the historical values of each macro-financial variable to the median value.

Table 2
Markov-switching model: in sample estimation of macro-financial state variables.

	Regime 1 (High)				Regime 2 (Low)			
	μ_1 (%)	σ_1 (%)	v_1	P_{11} (%)	μ_2 (%)	σ_2 (%)	v_2	P_{22} (%)
Changes in Interest rates	1.79	1.58	9.99	87.55	−1.66	1.40	7.98	91.98
(Standard error)	(0.44)	(1.29)	(2.58)	(0.45)	(0.11)	(1.05)	(1.25)	(0.35)
Changes in CAPE	0.85	2.28	10.00	96.93	−1.47	4.61	6.01	89.58
(Standard error)	(0.14)	(0.69)	(4.58)	(0.44)	(0.65)	(1.38)	(6.53)	(0.84)
Market Volatility	1.25	0.34	5.80	96.72	0.71	0.11	10.10	86.70
(Standard error)	(0.04)	(0.96)	(1.64)	(0.29)	(0.01)	(0.59)	(1.89)	(0.28)
Changes in INDPRO	0.28	0.25	10.58	99.63	−0.43	0.36	5.45	92.82
(Standard error)	(0.02)	(0.33)	(1.25)	(0.26)	(0.10)	(1.01)	(1.42)	(0.72)

Note: This table summarizes the in-sample estimates of the Markov-switching model. We report the maximum likelihood estimate of the regime-specific mean (μ) and standard deviation (σ) and degrees of freedom (v) of each variable, together with the estimated standard error. We also report the persistence of each regime which is defined as the estimated transition probability of staying in the current regime.

4.2. Performance prediction

At each of the rebalancing dates t, a style is chosen for allocation that best fit the regimes in a specific macro-financial variable. Let us also assume that we know the current state of the macro-financial variable and we can estimate the in-sample probabilities of both regimes as discussed in Section 4.1. If the current state is in regime H then the realized mean and volatility is denoted by $\mu_{H,t}$ and $\sigma^2_{H,t}$ respectively and in case of regime L the realized mean and volatility are then given as $\mu_{L,t}$ and $\sigma^2_{L,t}$. The expected returns and volatility of each Shariah-compliant style at $t+1$ depends on the expectations of regimes at $t+1$. Therefore, we weight the possible realization of expected mean $\mu_{t+1|t}$ and volatility $\sigma^2_{t+1|t}$ with their respective probabilities. Suppose, as in Ang and Bekaert (2004), that the model indicates at time t a high regime for the macro-financial variable at time $t+1$. Then, the conditional expected return and variance of the equity style return is:

$$\mu_{t+1|t} = \pi_{H,t+1|t}\mu_{H,t} + (1-\pi_{H,t+1|t})\mu_{L,t}, \tag{6}$$

$$\sigma^2_{t+1|t} = \pi_{H,t+1|t}\sigma^2_{H,t} + (1-\pi_{H,t+1|t})\sigma^2_{L,t} + \pi_{H,t+1|t}(1-\pi_{H,t+1|t})\left(\mu_{H,t}-\mu_{L,t}\right)^2, \tag{7}$$

where $\pi_{H,t+1|t}$ is the predicted probability of staying in regime H.

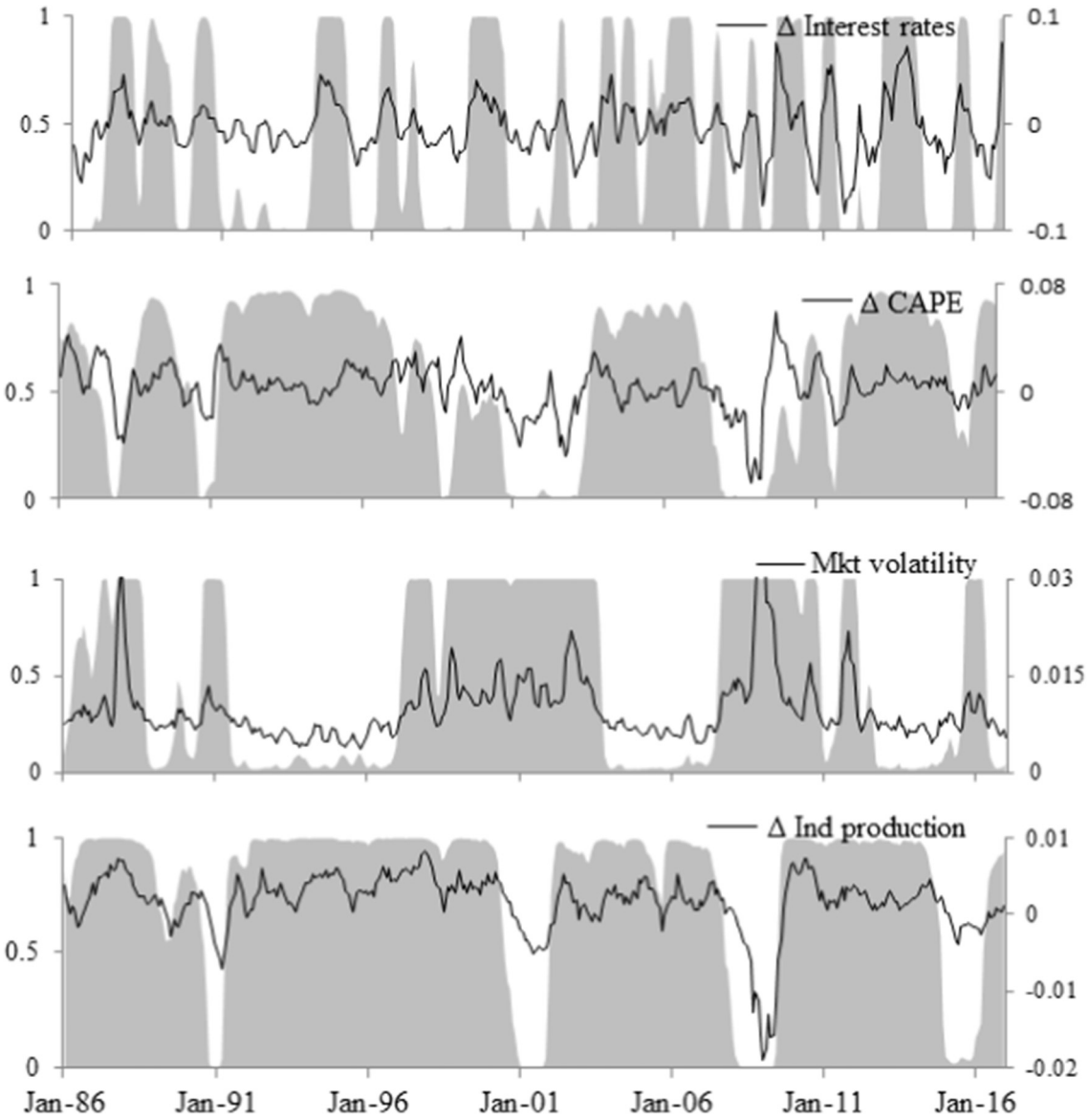

Fig. 4. The in-sample smoothened probabilities that the macro-financial variable is in a high regime (grey area), together with the time series plot of the macro-financial variable. *Note:* This figure shows the time series plot of the historical values of the four macro-financial variables (black lines on the secondary axis (right side)). The smoothened probabilities of high regimes in each macro-financial variables (the area in gray) is plotted using the primary axis (left side).

4.3. Designing dynamic Shariah-compliant style allocation strategies

A simple approach to style diversification starts by allocating an equal amount to each of the four single style Shariah-compliant portfolios as the baseline portfolio. The equally-weighted dynamic style allocation strategy (EWDS) does not exploit market information. Due to the difference in performance as observed in the above section, we argue that better performance can be achieved through efficient style diversification by utilizing the information in the estimated regimes of the four state-variables namely, change in interest rate, change in CAPE, change in industrial production, and market volatility. The information provided by each macro-financial regime can then be used to design regimes-driven market timing and diversification strategy that reallocate weights among the portfolio styles at the rebalancing date in a dynamic portfolio.

To determine the out-of-sample weights of the dynamic strategy, we first estimate the risk-adjusted returns of each of the Shariah-compliant styles in a specific macro-financial variable. At time t, the predicted value for the next period RAR is given by:

$$\widehat{RAR}_{t+1|t} = \frac{\hat{\mu}_{t+1|t}}{\hat{\sigma}_{t+1|t}}, \tag{8}$$

Table 3
Performance of Shariah-compliant portfolios in full sample and sub-sample based on high and low values for macro-financial variables.

	Full sample	ΔInterest		ΔCAPE		Volatility		ΔInd prod	
		High	Low	High	Low	High	Low	High	Low
Frequency (%)		43.81	56.18	62.90	37.09	46.50	53.49	83.06	16.93
Panel A: Market capitalization-weighted portfolio									
Mean (%)	8.51	6.64	10.15	14.84	−1.26	3.70	13.07	12.46	−8.21
Vol (%)	14.73	14.11	15.35	11.18	19.27	18.72	10.20	14.01	17.56
RAR	0.57	0.47	0.66	1.32	−0.06	0.19	1.28	0.88	−0.46
Panel B: Fundamental value-weighted portfolio									
Mean (%)	8.78	6.99	10.37	15.13	−0.96	4.70	12.67	11.88	−4.50
Vol (%)	13.97	13.70	14.32	10.79	18.05	17.70	9.77	13.46	16.20
RAR	0.62	0.50	0.72	1.40	−0.05	0.26	1.29	0.88	−0.27
Panel C: Equal-weighted portfolio									
Mean (%)	10.37	7.04	13.24	16.65	0.78	6.27	14.31	13.32	−2.20
Vol (%)	17.08	16.09	17.97	12.25	23.14	22.19	11.09	16.02	21.76
RAR	0.60	0.43	0.73	1.35	0.03	0.28	1.29	0.83	−0.10
Panel D: Low-risk weighted portfolio									
Mean (%)	10.15	8.14	12.02	16.52	0.63	4.80	11.36	11.95	2.86
Vol (%)	12.86	13.71	12.38	10.73	15.76	15.88	9.66	12.68	14.20
RAR	0.78	0.59	0.97	1.53	0.03	0.30	1.17	0.94	0.20

Note: This table reports the in-sample annualized returns, risk and risk-adjusted returns ratio of Shariah-compliant equity portfolios. The results are presented for the time period 1986–2016 and sub-periods. The sub-period analysis is based on high-low regimes in macro-financial variables. The frequency shows the number of times a regime is identified. The regimes are identified if the smoothened probability of a specific regime is higher than 50%.

where $\hat{\mu}_{t+1|t}$ and $\hat{\sigma}_{t+1|t}$ are the conditional mean and volatility estimates from Section 4.2. The dynamic strategy then bases the allocation decision on the RAR of each Shariah-compliant style i.e., it invests in the hitherto best performing style in terms of highest predicted risk-adjusted returns. It is important to note that the weights are dependent on regimes in macro-financial variables and we consider each variable as equally important, such that a style receives a weight of $K/4$, with K the number of macro-financial variables for which the corresponding regime switching model predicts that the style will have the highest risk-adjusted returns. We call this dynamic strategy the Markov Regime Driven Style (MRDS) allocation. It is important to mention here that the portfolios are fully invested (the sum of weights allocated to all styles is 1) and do not allow for short selling because of non-permissibility in Shariah.

5. Out-of-sample analysis

The process starts with forecasting regimes based on the dynamics in the macro-financial variables. We then evaluate the in-sample performance of each single style Shariah portfolio for each of these regimes. The in-sample performance lays the foundation for investment decisions. Our analysis shows that risk and return characteristics of single style Shariah-compliant portfolios are time-varying and are partially driven by macro-financial regimes. To utilize the time-varying nature of different Shariah-compliant portfolios in various macro-financial regimes, we propose the MRDS strategy whereby investments in the portfolio are dynamically adjusted at the beginning of each period among four styles based on the information provided by macro-financial regimes. The out-of-sample performance is based on the monthly returns for the period 1996–2016 and follows a ten year estimation window.

5.1. Weight allocation to each style factor by the MRDS strategy

Table 4 shows the average frequency of selecting a single style in the MRDS portfolio. The selection frequency is estimated as the number of times a macro-financial variable guides investing in a Shariah-compliant style at a rebalancing date. Table 4 shows that the odds of selecting the low-risk-weighted portfolio are three to five times higher than other style portfolios. This observation supports the finding reported in Table 3 where a low-risk investment strategy most of the time results in higher risk-adjusted returns. Among other styles market capitalization has the highest selection frequency in CAPE regimes, fundamental value-weighted is more favored by regimes in market volatility, and the equal-weighted strategy has been selected most of the times by changes in interest rates.

Fig. 5 shows that the weights are not well diversified during the dot-com crises. In fact, due to the prolonged market rally, the weights are concentrated in the market capitalization strategy. In the post crisis periods, the equal-weighted and low-risk strategies receive relatively higher weights. During the global financial crisis, the higher allocation converged to the low-risk strategy. This shows that the MRDS Shariah strategy successfully mitigates risk. Based on the total out-of-sample period the market capitalization, fundamental value, and equal-weighting strategies receive an average 11.71% and 12.20% and 13.59% weights respectively. The remaining 62.50% of the MRDS portfolio is invested in the low-risk portfolio.

Table 4
Out-of-sample selection frequency of single style Shariah-compliant equity styles in the MRDS portfolio.

	Δ Interest rates	Δ CAPE	Market vol	Δ Ind Pro
Market capitalization-weighted portfolio	27	34	31	26
Fundamental value-weighted portfolio	32	33	36	22
Equal-weighted portfolio	48	36	44	9
Low-risk weighted portfolio	145	149	141	195

Note: The frequency of selection shows the number of times a Shariah-compliant equity style is selected by the MRDS strategy throughout the out-of-sample evaluation period (1996–2016).

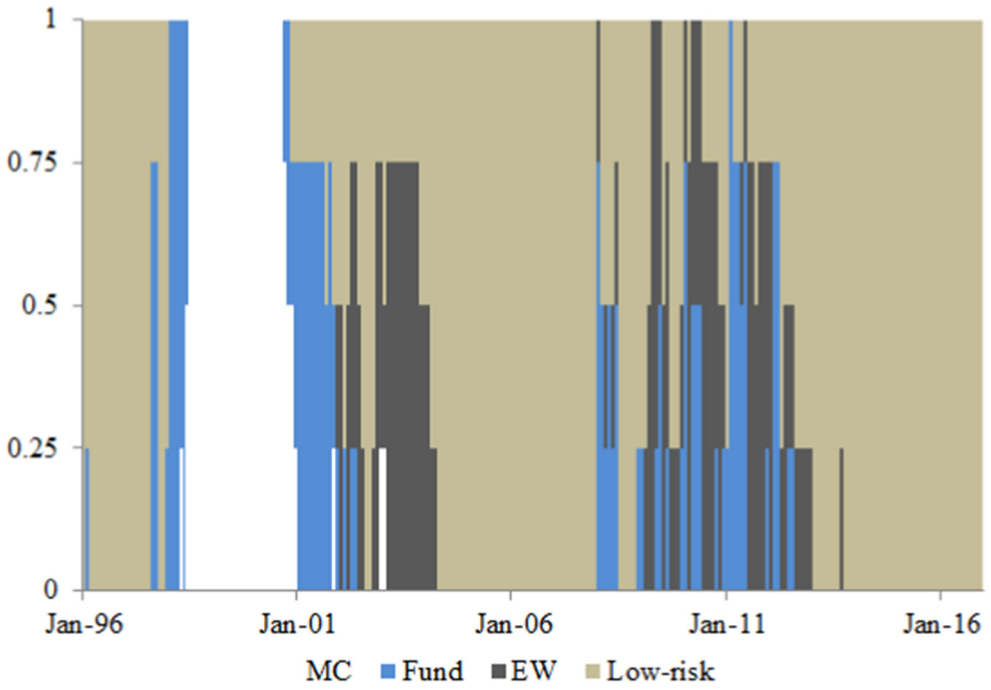

Fig. 5. Out-of-sample weight allocation to the four equity-style portfolios by the MRDS strategy. *Note:* In Fig. 5 we show the weight allocation by the MRDS strategy to market capitalization (MC), equal-weighted (EW), fundamental value-weighted (Fund), and low-risk weighted portfolios (Low-risk). This figure shows the weights of the MRDS Shariah strategy when implemented with all four strategies. The out-of-sample weights are estimated with monthly frequency for the period 1996–2016.

5.2. The effect of the allocation methods on the relative performance of Shariah-compliant strategies

In order to evaluate the stability of returns, we plot the ratio of the cumulative value of $1 invested in each single style Shariah-compliant portfolio and MRDS strategy as compared with the cumulative value of $1 invested in the portfolio applying the EWSD as a benchmark strategy. The slope of the line is important when interpreting the time-variation in relative performance. A positively sloped graph indicates an outperformance of the single style and the MRDS strategy compared with the benchmark strategy, and vice versa if it is downward sloping. Fig. 6 shows the clear impact of the MRDS strategy on the stability of returns of single style Shariah-compliant strategies and EWDS.

We can infer three important findings from Fig. 6. First, though the relative performance of the MRDS portfolio exhibit few shocks (e.g., at the burst of the doc-com bubble), we find that overall the MRDS strategy results in a more stable financial performance as compared to other single style strategies. Among the single style strategies, the relative performance of market capitalization and fundamental value-weighted strategies exhibited an upward trend during the dot-com bubble, however, a declining trend can be observed over the long run indicating their under performance relative to EWDS and MRDS strategies. The equal-weighted and low-risk strategies show an upward trend indicating an outperformance in the long-run. However, this comes at the cost of less stability in returns as relative performance shows high volatility over time.

Second, the MRDS strategy successfully negotiated crisis periods and showed relatively stable returns whereas single style Shariah-compliant portfolios shows considerable volatility and drift especially after the Dot-Com crisis. This suggests that the efficient timing of the MRDS strategy results in successful mitigation of overall risk.

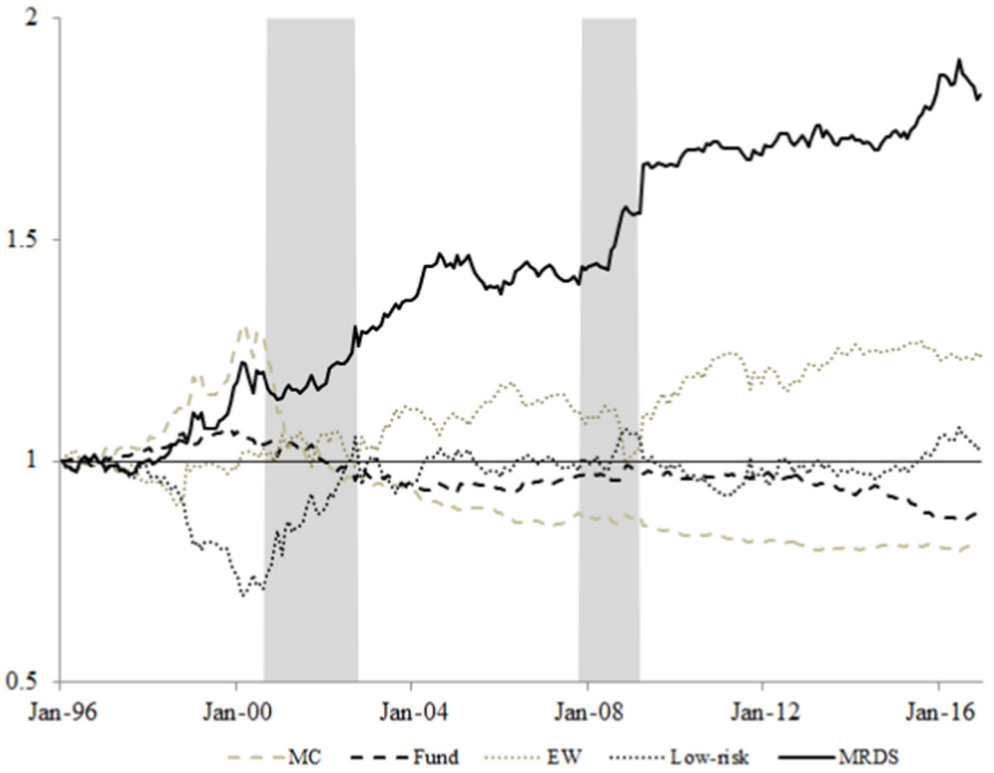

Fig. 6. Out-of-sample relative performance of single style Shariah-compliant portfolios and a MRDS portfolio, as compared to EWDS Shariah-compliant portfolio. *Note:* MC stands for market capitalization, Fund shows fundamental value-weighted, EW shows equal-weighted, Low-risk represents low-risk strategy, and MRDS shows Markov Regime Driven Style allocation Shariah-compliant portfolios. The two gray zones show the two major crises between 1996 and 2016. We identify those crises as the two periods reporting the largest drawdowns: the burst of the Dot-com bubble (September 2000–September 2002) and the global financial crisis (November 2007–February 2009.). The analysis is based on out-of-sample returns with monthly rebalancing for the period 1996–2016.

Finally, in terms of cumulative value for the time period 1996–2016, the MRDS strategy is able to generate additional benefits as compared with the benchmark strategy and all individual style Shariah-compliant portfolios.

5.3. Effect of the MRDS strategy on the performance of single style Shariah-compliant portfolios

The relative performance in Fig. 6 shows that the MRDS strategy has more stability in returns as compare to single style Shariah-compliant portfolios. Most importantly, the stability in returns does not come at a cost. Table 5 shows the raw per-

Table 5
Out-of-sample performance of single style Shariah-compliant portfolios and dynamic Shariah-compliant portfolios

	Mean (%)	Vol (%)	RAR	MDD (%)	VaR (%)	Skew	Kurt
Panel A: Single style Shariah-compliant equity portfolios							
Market capitalization-weighted (MC)	6.91	14.43	0.47	50.65	−6.68	−0.48	0.72
Fundamental value-weighted (FW)	7.34	13.66	0.53	40.27	−6.16	−0.41	1.05
Equal-weighted (EW)	9.14	17.01	0.53	47.27	−7.34	−0.23	1.77
Low-risk strategy (LRS)	8.19	11.53	0.71	36.14	−5.31	−0.78	2.09
Panel B: Dynamic portfolios							
EWDS	8.01	13.49	0.59	40.75	−6.13	−0.53	1.32
MRDS	11.17	13.39	0.83***	34.40	−5.29	−0.22	1.52

Note: This table reports the annualized returns (Mean (%)), annualized volatility (Vol (%)), risk-adjusted returns (RAR), maximum drawdown (MDD (%)), Value-at-Risk (VaR (95% confidence interval, in percent)), skewness (Skew), and excess kurtosis (Kurt) for single style Shariah-compliant portfolios, equally weighted dynamic style allocation strategy (EWDS) and MRDS Shariah-compliant portfolios invested in all S&P 500 stocks. For the risk-adjusted return ratio, the table also shows the results of significance tests, where *, **, and *** indicate that the RAR ratio differs significantly from the RAR ratio of the market capitalization Shariah-compliant portfolio, at the 10%, 5%, and 1% levels based on the t-test with HAC standard errors. The out-of-sample analysis is based on monthly data for the period of 1996–2016.

formance (annualized returns) and risk-adjusted performance (measured with RAR) of all single style Shariah-compliant portfolios, the MRDS strategy, and the EWDS strategy.

The performance results in Table 5 are divided into two panels. Panel A displays the performance attributes of single style Shariah-compliant portfolios; Panel B presents the dynamic portfolios. Results show that the MRDS strategy not only outperforms all single style Shariah-compliant portfolios but also the EWDS as the benchmark. The superior performance of MRDS does not come at a cost as it reduces the volatility of all single style Shariah-compliant portfolios (except low-risk strategy). If we look at other risk measures like maximum drawdowns and value-at-risk, the MRDS strategy shows more sta-

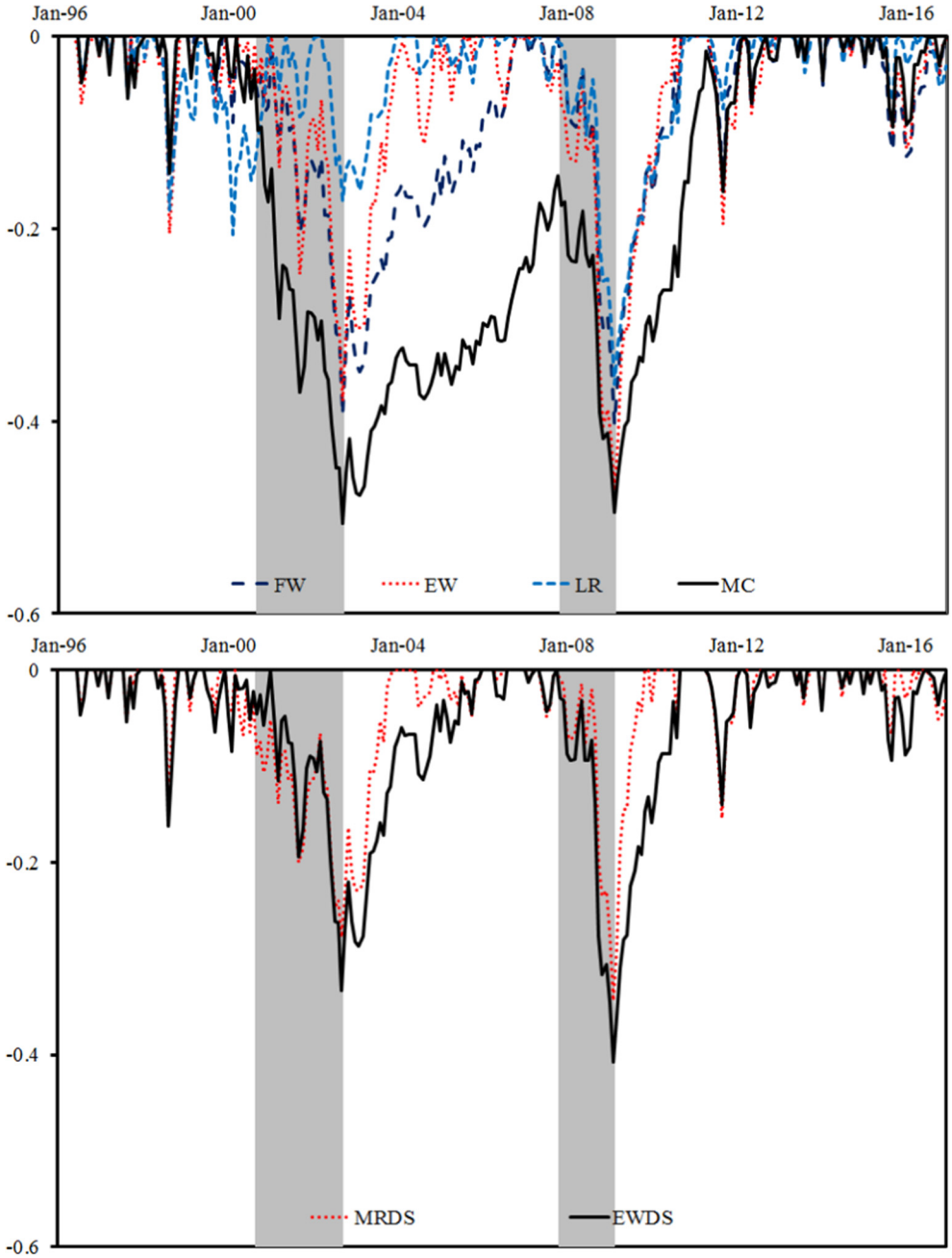

Fig. 7. Out-of-sample drawdown analysis of single style Shariah-compliant portfolios (top panel) and the dynamic allocation of the MRDS and the EWDS (bottom panel). *Note:* The top panel shows the drawdowns of market capitalization (MC), fundamental value-weighted (FW), equal-weighted (EW) and Low-risk (LR) portfolios. The lower panel shows the drawdowns of MRDS and EWDS portfolios. The two gray zones show the two major crises between 1996 and 2016. We identify those crises as the two periods reporting the largest drawdowns: the burst of the Dot-com bubble (September 2000–September 2002) and the global financial crisis (November 2007–February 2009). The analysis is based on out-of-sample monthly returns with monthly rebalancing for the period 1996–2016.

bility (less risk) even in a comparison to the low-risk strategy. The MRDS strategy also outperforms the benchmark portfolio (EWDS) in terms of stability, annualized returns, and the risk-adjusted performance ratio. It is also interesting to note that the skewness of the MRDS is less negative than the skewness of the EWDS strategy.

5.4. Drawdown analysis

The analysis in Section 5.3 shows that the MRDS strategy successfully reduces the maximum drawdowns of all single style Shariah-compliant strategies and benchmark strategies. However, stability in financial performance can be more important for Shariah-compliant portfolios rather than the maximum amount of losses at a specific period. There could be many periods of small and average losses over the investment horizon. We, therefore, plot the drawdowns of all single style Shariah-compliant portfolios, the benchmark portfolio, and the MRDS strategy. The drawdowns are presented in Fig. 7. The shaded area shows the two major crises that occurred between from 1996 to 2016.

Fig. 7 shows that market capitalization and equal-weighted strategies faced huge losses around the burst of the dot-com bubble in September 2000 - September 2002 and during the global financial crisis in November 2007 - February 2009. In comparison the MRDS strategy exhibit relatively lower drawdowns during most of the period. The lower drawdowns of the MRDS strategy is one of the reasons for long-term stability in returns. The MRDS strategy achieves this by successfully utilizing the time-varying returns characteristics of the single style Shariah-compliant portfolios.

6. Conclusion

The investment universe of Islamic investors is constrained due to compliance with Shariah screening criteria. The restriction on the type of investments is clearly stated, however, the investor is free to choose the investment allocation strategy. This study contributes to the growing literature of investment strategies in general and Islamic asset allocation strategies in particular by introducing a dynamic allocation strategy which optimally utilizes the time-variation in the risk and returns performance of portfolio components. We propose a dynamic allocation strategy called "Markov Regime Driven Style allocation" strategy for optimizing Shariah-compliant investment portfolios. This strategy is led by the regimes in macro-financial variables as captured by the Markov regime switching model. This dynamic allocation strategy, as compared to single style Shariah-compliant portfolios, achieves higher stability in financial performance by dynamically allocating across different Shariah-compliant equity styles.

By focusing on a sample of Shariah-compliant stocks of the S&P 500 universe for the time 1986–2016, we find that the time-varying performance of Shariah-compliant equity styles depends on the macro-financial regime, as indicated by the low and high Markov states of changes in interest rates, changes in CAPE, changes in industrial production, and market volatility. Our out-of-sample analysis for the period 1996–2016 shows that the MRDS strategy that is driven by Markov regimes outperforms all single style Shariah-compliant portfolios and also the equal-weighted Shariah style diversification strategy both in terms of raw and risk-adjusted returns. By the timely allocation of weights across each Shariah style the proposed MRDS portfolio improves the level and stability of single style Shariah-compliant equity portfolios. It also successfully improves the performance in market downturns and prolonged market rallies.

The proposed dynamic style portfolio is a useful addition to the financial toolkit of the Shariah-compliant equity investor. This tool can be used to achieve stability in portfolio returns by timely adapting their investment portfolio as a function of the time-varying risk-reward properties of single style Shariah-compliant portfolios. An interesting direction for further research is to investigate whether the proposed MRDS allocation in Shariah-compliant stocks is also beneficial for the conventional investor.

Acknowledgement

We would like to thank Professor Jonathan Batten, Dr. Barbara Marie L'Huillier, and Dr. Zamir Iqbal for their valuable feedback on an earlier draft. We also like to thank Shaheed Benazir Bhutto University Dir, Pakistan and the Higher Education Commission, Pakistan for providing financial support.

The views expressed in this paper are those of the author(s) and do not necessarily reflect the views of the Islamic Research and Training Institute or the Islamic Development Bank Group. All the remaining errors are the responsibility of the authors.

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